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Some notes on Western Umbelliferæ. II.

JOHN M. COULTER AND J. N. ROSE.

Eryngium petiolatum Hook. has been made to contain all our Pacific forms, until that species has become a collocation of most dissimilar plants. In our study of this group, the nebulous mass called E. petiolatum has been resolved into at least four distinct forms. We have characterized E. petiolatum as follows: Erect, 1 to 5 feet high, branching above (or from the base in low forms): radical leaves oblanceolate, spinosely and unequally serrate, attenuate into an elongated fistulous petiole (submerged leaves consisting only of the terete jointed petiole); stem-leaves mostly sessile: involucral bracts linear-lanceolate, spinosely-tipped and toothed (sometimes an inch long), longer than the peduncled globose head; bractlets lanceolate, cuspidate-tipped, scarious-margined below, but little longer than the flowers: calyx-lobes resembling the bractlets, but smaller, much shorter than the long styles.—Mostly in marshes, throughout California (*Greene, Lemmon* 108, *G. R. Vasey* 223 and distributed as var. *armatum*, *Cleveland*, etc.). We have seen no Oregon representative of this species. It varies greatly in size, and in drier places passes into a dwarfed form but 1 to 3 inches high, with all the parts correspondingly reduced (Donner Lake, *C. F. Sonne*).

We would disentangle the following three species from E. petiolatum, giving chiefly the points of difference:

Eryngium armatum, n. sp. Diffuse, branching throughout, a foot or so high: serrate to spinose-dentate or incised radical leaves attenuate into a short more or less margined petiole: involucral bracts and bractlets lanceolate (broadest at base), entire (rarely toothed at base), rigid, thick margined, much longer than the head: calyx-lobes acuminate-lanceolate, longer than the short styles.—*E. petiolatum*, var. *armatum* Watson, Bot. Calif. 1. 255.—California, from San Diego to Humboldt and Butte counties. Its range has been extended southward from that given in the Botany of California by *Palmer* 155 (San Luis Obispo) and *Orcutt* (San Diego), as well as to Butte county by *Mrs. R. M. Austin*. In the collections of Pringle, Orcutt, and Mrs. Austin, it was distributed as *E.*

petiolatum, from which it differs in its low, diffuse branching habit, short petioled radical leaves, broad entire rigid bracts and bractlets, all similar and conspicuously longer than the head, and short styles.

Eryngium Vaseyi, n. sp. Stems a foot or less high (sometimes reduced to 2 or 3 inches), several from a common root and branching above: leaves unequally spinulose-serrate, attenuate below: involucral bracts and bractlets narrow, thick and rigid, spinose and spiny-toothed, much longer than the head: calyx-lobes lanceolate, acuminate-cuspidate, longer than the short styles.—In wet ground, California, San Antonio river, July, 1880 *(G. R. Vasey* 222, distributed as *E. petiolatum)*, and Chico *(Mrs. R. M. Austin);* S. W. Oregon, near Medford *(Howell*, a much reduced form).—This species is remarkable for its narrow, very spiny bracts and bractlets, much more rigid than in *E. armatum* and spiny-toothed. The calyx-lobes also have stronger cuspidate tips than in that species.

Eryngium articulatum Hook. Erect, 1 or 2 feet high, more or less branching throughout: radical and lower stem-leaves reduced to very long (sometimes a foot long) jointed petioles, with or without a small lanceolate blade (from entire to laciniately toothed): involucral bracts linear, cuspidate-tipped and spiny-toothed (about half-inch long), longer than the head; bractlets tri-cuspidate, the middle one much the largest, scarcely longer than the flowers: calyx-lobes lanceolate, cuspidate-acuminate, hardly longer than the styles.—*E. petiolatum*, var. *juncifolium* Gray, Proc. Am. Acad. viii. 385.—Swamps and wet meadows, Washington Territory, Falcon Valley *(Suksdorf);* Oregon *(Nuttall, Hall* 200, *Howell, Henderson);* California, Plumas county *(Mrs. R. M. Austin).* Numerous very immature specimens of this species are to be found in herbaria in which the bracts seem very prominent; but it is simply owing to the immaturity of the heads. This is the western representative of the eastern E. Virginianum group.[1]

Peucedanum Martindalei, n. sp. Resembling *P. Hallii* in

[1] The following species, a member of this group, turns up among Florida collections labeled *E. prœaltum* Gray:

E. Floridanum, n. sp. Erect, 2 or 3 feet high, somewhat branching above: lower leaves narrowly oblong (1 to 4 inches long), mostly entire, on long fistulous jointed petioles (sometimes a foot long); upper ones becoming sessile, elongated-linear, usually remotely serrulate: involucre of linear-lanceolate, rigid, sharp-pointed, entire or spiny-toothed, reflexed bracts longer than the subglobose heads; bractlets linear, rigid, entire, tapering to a pungent tip, much longer than the flowers: fruit scaly, with short ovate acute calyx-lobes, and very long rigid styles.—Brackish marshes, Florida, Tampa (*Garber*), and near Jacksonville (*Curtiss*). Distributed as *E. prœaltum* Gray, but differing from all species of that group in its entire bractlets.

habit and foliage, but differing in leaves, sometimes bipinnate with toothed or pinnatifid segments; fruit 4 to 7 lines long, 3½ lines broad, with wings much broader than body (which is but a line), and prominent dorsal and intermediate ribs; oil-ducts solitary in the intervals, 2 on the commissural side; and seed-face somewhat concave, with central longitudinal ridge.—Rocky places, Cascade Mountains, Oregon (*Howell*, 1880), flowering in May. Distributed as *P. Hallii*, but differs decidedly in its fruit characters. Dedicated to Mr. I. C. Martindale, to whose collection of Umbelliferæ we are very much indebted.

Var. **angustatum.** Usually more caulescent and taller, with more dissected leaves, and wings of fruit but half a line wide, making a fruit 2 lines wide.—Oregon, Cascade Mountains *(Howell)*, Mt. Paddo *(Suksdorf)*; Washington Territory *(Brandegee* 323, *Tweedy* 281); also Vancouver Island, Mount Arrowsmith, alt. 5,500 feet (*Macoun* 19). Also distributed as *P. Hallii*.

Peucedanum Donnellii, n. sp. Shortly caulescent or acaulescent, 6 to 12 inches high, glabrous, from a fusiform root: leaves ternate and then pinnately decompound, with segments pinnately cleft into short oblong or linear lobes: umbel somewhat unequally 6 to 12-rayed, with mostly no involucre, and involucels of linear acuminate bractlets; rays 1 to 4 inches long; pedicels 2 to 8 lines long; flowers yellow: fruit ovate to broadly oblong, glabrous, 3½ to 4 lines long, 2 to 3 lines broad, with wings less than half as broad as body, and prominent dorsal and intermediate ribs: oil-ducts small, 4 to 6 in the intervals, 4 to 6 on the commissural side.—Oregon (*Cusick* 36, in 1883), John Day Valley (*Howell* 829, in 1885). Flowers in April. Most nearly related to *P. Nevadense* Wats. Dedicated to John Donnell Smith, in whose collection the species was first detected.

Peucedanum Californicum, n. sp. Short caulescent, glabrous, with a solitary peduncle rising from 4 inches to a foot high: leaves clustered near the base, large (4 to 6 inches long), bipinnate (the upper leaflets confluent); leaflets broad, obtuse (usually ending truncately or emarginately between two divaricate teeth), irregularly incised and with broad strongly cuspidate teeth: umbel 8 to 10-rayed, with no involucre, and involucels of distinct lanceolate acuminate bractlets: rays 1 to 1½ inches long; pedicels about 3 lines long; flowers yellow: fruit (immature) ovate, glabrous: oil-ducts solitary in the intervals, 2 on the commissural side.—San Luis Obispo,

California, May 5, 1882 (*Marcus E. Jones*). Distributed as *P. parvifolium* T. & G. This is a very distinct species of the *Euryptera* section.

Peucedanum Vaseyi, n. sp. Shortly caulescent, 6 to 8 inches high, pubescent: petioles wholly inflated; leaves small (1 to 2 inches long), bipinnate, with the small ovate segments irregularly 3 to 5-lobed: umbel equally 2 to 5-rayed, with no involucre, and involucels of obovate petiolulate toothed bractlets; rays an inch long; pedicels a line or two long: flowers yellow: fruit broadly oblong, emarginate, glabrous, 6 or 7 lines long, 4 lines broad, with wings twice as broad as body, and prominent dorsal and intermediate ribs: oil-tubes solitary in the intervals, 4 on the commissural side.—San Bernardino Mountains, California, May, 1880 (*G. R. Vasey* 231); mesas, San Bernardino, April, 1881 (*S. B. & W. F. Parish* 286 in part). Distributed by Vasey as *P. macrocarpum* Nutt., var.; and by Parish as *Cymopterus terebinthinus* T. & G.

Selinum Grayi, n. sp. Stout (sometimes very much so), 1 or 2 feet high, glabrous except the more or less scabrous inflorescence, leaf-margins, and veinlets (beneath): leaves once to twice pinnate, with much dilated petioles; leaflets oblong to ovate, about an inch long, acute, toothed (sometimes lacinately-toothed or lobed): umbels with involucels of conspicuous lanceolate-ovate long-acuminate bractlets; rays 1 to two inches long; pedicels 1 to 2 lines long: fruit oblong, glabrous, 2 to 2½ lines long, with prominent thin wings, the lateral ones decidedly broadest: oil-ducts conspicuous: seed dorsally sulcate.—High mountains of Colorado (*Vasey* in 1868, *Canby* in 1871, *Coulter* in 1873, *Trelease* in 1886); also probably *Hall & Harbour* 219 and *Parry* 154. Distributed as Archangelica Gmelini, and so called in the Flora Colorado and Coulter's Rocky Mountain Manual. So far as we have seen all the Archangelica Gmelini reported from Colorado is this species. Its general habit resembles that of an Angelica somewhat, but its fruit characters are very different, and entirely those of Selinum.

Selinum Dawsoni, n. sp. A foot or so high, glabrous: leaves ternate then bipinnate, the small (¼ to ½ inch long) ovate acute segments laciniately toothed to entire: umbels with involucels of linear-oblong scarious bractlets longer than the pedicels and abruptly ending in a long attenuation; pedicels 1 to 2 lines long: fruit oblong, smooth, about 2 lines long, with prominent thin wings, the lateral ones but little broader: oil-ducts conspicuous, rarely an additional small one in a

lateral interval: seed hardly at all dorsally sulcate.—Pelly River, at Pelly Banks, Yukon, lat. 61°, August 11, 1887 (*Dawson* 23). This interesting species is quite distinct from all our Selinums in its leaf and involucral characters, as well as in the prominent thin wings of the fruit.

Cœlopleurum Gmelini Ledeb. The range of this species has been confused by referring to it *Selinum Grayi* C. & R. of the Colorado Rocky Mountains. Occurring on the Atlantic coast from Massachusetts Bay to Labrador, we have seen no specimens from the Pacific coast south of Vancouver Island (*Macoun*). It extends from that island to Alaska, and very likely will be found on the coast of Washington Territory and Oregon. We have not discovered that this species is found at all in the interior. In Washington Territory, however, the following coast species has been discovered:

Cœlopleurum maritimum, n. sp. Stem 2 to 3 feet high: leaves 2 to 3-ternate; leaflets broad, often round, usually with cordate base, very obtuse, dentate or crenate-dentate, 2½ to 3 inches long, 2½ inches broad: umbel many-rayed, with involucels of linear-lanceolate bractlets; rays 2 to 3 inches long; pedicels 6 to 7 lines long: fruit oblong, 3 to 3½ lines long, with lateral ribs broadest and seed-face concave.—Wet ocean bluffs, Long Beach, Ilwaco, Washington Territory, July 24, 1886 (*L. F. Henderson* 384).

Ligusticum apiifolium Benth. & Hook. This species is found chiefly in the mountains of Oregon, and extends into California. It is very evident, from a study of herbarium specimens, that it has been much misunderstood; for, while we discover any number of sheets labeled *L. apiifolium*, very few of them prove to be that species. The Oregon plant is represented in the older collections by *Hall* 207, and recently by *Howell* 6 and *Henderson* 1589. The Californian stations are Yosemite valley (*Bolander*), Big Tree road and Ebbett's Pass (*Brewer*), and Donner Lake (*Torrey*). The small oval fruits, smaller than in any other species, with their narrow ribs and reniform seed-section, easily separate it from other Ligusticums. Its range, apparently limited to the mountains of Oregon and N. California, serves well to separate it from the Colorado L. scopulorum, with which it seems to have been confused.

Ligusticum scopulorum Gray. So far as we can discover, this species does not occur beyond the Rocky Mountains, and chiefly in Colorado. It extends also into N. Arizona (*Palmer* 176, *Rusby* 630). Certain Colorado forms, with im-

mature fruit, referred to this species, differ somewhat in foliage from typical L. scopulorum, and simulate Coniosellinum Canadense so very closely that mature fruit is necessary to distinguish them. Collectors should carefully note whether any so-called specimens of L. scopulorum develop fruit with lateral wings. These wings are often developed so late in the maturing of the fruit that it must be fully ripe before any decision can be made.

Wabash College, Crawfordsville, Ind.

Zygomorphy and its causes. I.

CHARLES ROBERTSON.

Since reading a foot-note in Gray's Structural Botany[1] referring to the observation of Sprengel, that irregular flowers are adapted to insects, and "that strictly terminal and also vertical flowers, whether erect or suspended, are seldom irregular, while comparatively horizontal or obliquely set flowers more commonly are so," and also referring to the remark of Darwin,[2] "that he does not know of a single instance of an irregular flower which is wind-fertilized," I have often wondered what are the conditions in the insect relations of horizontal flowers which make advantageous such variations as are in the direction of irregularity. In the observation of the behavior of insects on such flowers I have found answers to some of the questions thus suggested.

Two papers on the causes of zygomorphy have recently appeared, one by Herman Vöchting[3] and the other by Frederick Delpino.[4] My observations approach the subject from a stand-point so different that it is hardly necessary to give more than references to these papers. However, it may be well, by way of introduction, to mention some of the points considered by Delpino; and I am more inclined to do this from the fact that he introduces a few terms which are convenient in characterizing irregular flowers.

Of the causes which are supposed to have operated in the production of floral irregularity Delpino recognizes three categories, viz., the instrumental and mechanical (cause stro-

[1] 219, note 1. [2] Forms of Flowers, 147.

[3] Ueber Zygomorphie und deren Ursachen. Jahrb. für wissench. Botanik. Bd. XVII, H. II, 1886, 297–346. See also Bot. Zeit. 1887, 436.

[4] Zigomorfia florale e sue cause, Malpighia, Anno I, Fasc. VI, 1886, 245–262.

mentali e meccaniche), the influencing or conditional (cause influenti o condizionali), the final, functional, or biological (cause finali, funzionali, o biologiche).

Of zygomorphy four grades are distinguished. In the first grade (recentissima) the irregularity is limited to a deflection of the stamens and styles. The second (recente) and the third (inveterata) form transitions to the fourth (inveteratissima), in which there is unequal development of one or more circles with partial or total abortions of certain organs, as in the orchids. Flowers of the first two grades belong to groups in which the types are regular, those of the last two belong to zygomorphous groups.

From the point of view of final or functional causes zygomorphy is an adaptation for cross-fertilization by special insects and honey-sucking birds. Most irregular flowers are adapted to bees (melittòfili). Many are adapted to hawk-moths (sfingofili) and birds (ornitofili), few to butterflies and flies. If the stamens and styles turn so as to strike the visitor on the back, the flower is *nototribe;* if they strike the under surface of the visitor, the flower is *sternotribe;* if pollen is applied to the side of the insect, the flower is *pleurotribe.*[5]

Nototribe flowers adapted to bees are most Labiatæ, Scrophulariaceæ, Bignoniaceæ, Lobeliaceæ, etc. Adapted to birds is Epiphyllum truncatum.[6] Sternotribe bee-flowers are most Papilionaceæ, Rhododendron, etc. Amaryllis formosissima is adapted to birds,[7] and Lilium longiflorum is sphingophilous. Pleurotribe flowers are adapted to bees, *e. g.*, Phaseolus, Lathyrus sylvestris and Polygala myrtifolia.[8]

Two proterandrous flowers, Teucrium Chamædrys and Ocymum Basilicum, are compared. The former is nototribe, the latter sternotribe. In the male stage in Teucrium the stamens turn down and the styles turn up; in Ocymum the stamens turn up and the style turns down. In the female stage in Teucrium the stamens turn up and the style turns down; in Ocymum the stamens turn down and the style turns up. These adaptive movements are referred to the operation of biological causes. Wind-fertilized flowers are actinomorphic, and belong to actinomorphic orders.

To the mechanical theory of De Candolle, that irregularity was caused by compression in the axils of leaves, *i. e.*,

[5] "Potendo darsi tre sorta d'impollinazioni, nototriba cioe, sternotriba e pleurotriba."

[6] Lobelia cardinalis and Salvia splendens are other examples. See Trelease Am. Nat. XIII. 427, and XV. 265.

[7] Tropœlum majus is commonly visited by the ruby-throated humming-bird.

[8] Perhaps better examples were described by J. E. Todd, Am. Nat. XVI. 281, Cassia Chamæcrista and Solanum rostratum.

between the leaves and the axis, it is objected that some terminal flowers are irregular, and many axillary flowers are regular.

The fifth stamen of didynamous flowers is partially or totally aborted, and is found in the plane of greatest pressure. But this stamen, if developed, would occupy the place of the style, and might defeat the contrivances for cross-fertilization, so that this abortion may also be referred to functional causes.[9] Admitting the association of the two sets of causes, which ought to be regarded as having more influence? Citing the case of Pentstemon and Jacaranda, in which the fifth stamen is even more strongly developed than the others, though not antheriferous, he says: "Behold, in this case the biological cause has triumphed over the mechanical."

In Ajuga and Teucrium the upper lip is reduced, which may be attributed to the action of mechanical causes, from being in the plane of greatest pressure, but in Salvia the upper lip is strongly developed. "Behold a new example of the prevalence of biological causes."

Since the pressure between the bracts and axis operates in a vertical direction the expansion ought to be in an horizontal direction; but the organs are most strongly developed in a vertical direction, in the plane of greatest pressure. Finally, the author concludes that, ninety times in a hundred, mechanical causes are subordinate to the functional.

To say that a flower is adapted to be cross-fertilized by certain insects seems to Delpino to be a sufficient explanation of it, but Mr. Darwin would say that it is only another way of saying that it is as we find it. If instead of "cause finali" we substitute natural selection, we shall have a known cause, and natural selection is a functional cause, since it operates only on variations which involve a functional advantage.

It is interesting, however, to observe that even teleological considerations may be sufficient objections to views which undertake to account for zygomorphy, while ignoring the selective influence of insects; for it is inconceivable that any cause, such as gravitation, should operate in such a regular way as to effect and maintain an adjustment to certain kinds of visitors. Suppose an insect lights on the stamens and styles of an horizontal flower, how can gravitation have more power to facilitate fertilization by turning these organs

[9] This abortion is attributed to natural selection by Müller (Fertilization of Flowers, 434) and Lubbock (Brit. Wild Flowers in Relation to Insects, 136).

up at the tips than to prevent it by turning them down? If it bends the styles in different directions fertilization will be more likely to occur in those flowers whose styles turn up. In this way the selective influence of insects will determine that only those flowers will be preserved whose styles are affected in a certain way by gravitation, so that the influence of gravitation will be subservient to the selective influence of insects. If, however, the action of the clinostat destroys the curvature of the styles, this character is said by Vöchting to be due to gravitation. If it fails to destroy other characters these are referred to an internal cause.

It seems to me that the principle of selection is the strength of the philosophy which undertakes to account for the origin of adaptations. There can be no doubt that different causes suggested by authors have operated to produce modifications in lateral flowers, but, as already observed, it is inconceivable that any of these causes should have had any influence in the absence of insects. On the other hand, insects can not be supposed to have produced variations, but, by determining that variations of a certain kind are advantageous, they are the cause of those modifications becoming permanent characters of the flowers, so that, after all, they may be considered to be the cause of the adaptations.

In a paper entitled "From Buttercups to Monk's-hood,"[10] Grant Allen follows a regular flower, like Ranunculus, through its transformations into an irregular form, like Aconitum. He says: "The secret of the monk's-hood depends, in the first place, upon the fact that the flowers are clustered into a spike instead of growing in a solitary isolation at the end of the stem, as in the common buttercups. Now, Mr. Herbert Spencer has pointed out that solitary terminal flowers are always radially symmetrical, and never one-sided, because the conditions are the same all around, and the visiting insects can light upon them equally from every side. But flowers which grow sideways from a spike are very apt to become bilaterally symmetrical; indeed, whenever they are not so one can always give an easy explanation of their deviation from the rule." * * "As each bee would necessarily light on the middle or lower portion of the flower, he would begin by extracting the honey from the two upper petals; but it would be rather awkward for him to turn head downward and suck the nectaries of the three bottom ones. Hence, in course of time, especially after the flower began to

[10] Pop. Sci. Monthly, XXIII, 65-68, reprinted from Knowledge.

acquire its present shape, the two top petals became specialized as nectaries, while the three lower ones gradually atrophied, since the colored sepals had practically usurped their attractive function." The views thus stated are not so fanciful as they may seem, as it is proposed to show in this paper. Instead of saying that the bee would "light on the middle or lower portion of the flower," I should say that he would light on the *middle*, and this will account for the fact that the nectaries are on the upper side. In those flowers in which the bee originally lighted on the *lower* part, the nectary is retained on the lower side and the upper nectaries abort.

Starting with the turning of a regular flower to an horizontal position, what conditions make certain modifications possible or advantageous? In the first place, an erect, regular flower attracts insects equally from all sides, and offers the expanded petals as a landing to a bee approaching from any direction. The nectaries are as conveniently reached from one side as from another. The dehiscent anthers are arranged so as to apply pollen to a bee sucking any of the nectaries. Or the nectaries and anthers are both set in the way of a bee lighting on any side. The stigmas are as likely to touch the insect coming from one side as from another.[11]

Whatever have been the causes of certain flowers assuming a more or less horizontal position, the principal advantage seems to have been a restriction of the visitors to the most diligent bees. Most of the flowers adapted to wasps, flies and butterflies, or to miscellaneous visitors, are erect and regular. The change to a lateral position has had the effect of excluding miscellaneous visitors, and has given bees the advantage, since they cling to the flowers more readily.

If small, closely crowded flowers become horizontal they may be subject to all of the conditions which are supposed to have produced irregular flowers; but they lack the selective influence of insects, and the importance of insect agency is shown from the fact that such flowers remain regular. Insects have the same relation to small, crowded, ateral flowers that they have to such flowers in flat-topped inflorescences, *i. e.*, they fertilize them by brushing over them, even pollinating many which they do not suck. They visit the inflorescence, but do not visit the single flowers in such a way as to have any particular relation to them. No one would suppose that the florets of Compositæ would become irregular by

[11] See K. F. Jordan, Die Stellung der Honigbehälter und der Befruchtungswerkzeuge in den Blumen, 1886, 54, 4).

becoming horizontal. The first condition, therefore, which is supposed to give rise to zygomorphy is that the flower must be large enough to offer some part of it as a landing to the insect.

If one wished to understand the most important characters of zygomorphic flowers he might ask this question: How did some flowers come to be sternotribe with nectaries on the upper side, and others nototribe with nectaries on the lower side? These peculiarities seem to have depended on what part of the flower originally offered a landing to the insect. Insects seem to prefer the stamens and styles as a lighting place, and to have used them as such in all cases except those in which these parts were concealed in a tube. This may be because these organs were most horizontal, or came in the way of the lower petals, and because the pollen which they bear is often the object of the visit.

According as the original characters of the flowers are supposed to favor the development of sternotribe or nototribe zygomorphy, we will consider flowers in two divisions: 1. Polypetalous (including monocotyledons), shallow gamopetalous and deep gamopetalous flowers with exserted stamens and styles. 2. Deep gamopetalous flowers with included organs.

Carlinville, Ills.

Notes on structures adapted to cross-fertilization.

AUG. F. FOERSTE.

(WITH PLATE VIII.)

Silene Pennsylvanica is proterandrous; the shorter stamens alternating with the petals maturing first, then the longer stamens. After the anthers are effete the styles separate, become hairy along one side and are ready for pollen. The cup beneath the ovary formed by the top of the anthophore forms a nectary, from which the honey may flow at times into the calyx tube below; owing to the length of this tube the flower would seem more adapted to fertilization by butterflies, but bees were most frequently observed. The crimson corolla turns bluish purple at the crown teeth as soon as the styles become effete, a sign for insect visits to cease.

Silene regia has scarlet flowers; the change of color in

the crown is far less marked. The stamens are all inclined to one side, the other side giving easy access to the nectary. The tips of the styles turn around into a loose coil, leaving the stigmatic portion on the outside of the coil directed slightly upwards, as though to insure more ready contact with the same on the part of visiting insects.

Sabbatia angularis secures the same effect by a moderate twisting of the stigma lobes, which causes the stigmatic surface to form a spiral about the lobes. In the stamens, also, the anthers, erect at first, become coiled at maturity, the coiling keeping pace with the dehiscence, which begins at the top, the top of the coil always keeping a fresh surface of the pollen exposed.

Psoralea Onobrychis has blue-purple flowers, with a greenish tinge on the center of the standard; length 4 or 5 mm.; visited by smaller-sized bees. The petals of the keel are not joined to one another, but are attached to the wings, being depressed with the same when bearing the weight of visiting insect, and at such times leaving the stamens and style exposed above the keel. Upon the pressure being released, the keel again springs up into its place.

Desmodium canescens has purplish-lilac flowers, with two whitish spots at the base of the standard, surrounded by a ring of dark purple, and serving as a guide to the opening of the flower beneath. The fact that the tenth stamen is free is *a priori* evidence of the existence of honey. The two petals composing the keel are each notched toward their base in such a manner as to leave a short projection on the outer side of the same. These projections fit into a groove in the lower part of the standard. When thus fitted the keel lies in tension, being held together around the stamens as long as the projections are held together in the groove of the standard. When a bee alights on the flower it thrusts its sucking tube beneath the standard, and in so doing spreads the keel apart, frees the projections of the keel from the grooves in the standard, and, with a quick jerk, keel and attached wings fly downward, leaving stamens and stigma in contact with the body of the intruder. The parts do not return to their former position, but change rapidly to a bluish tinge, indicating that the flowers are empty.

Lespedeza violacea has almost sessile, green, inconspicuous or minute cleistogamous flowers, chiefly in the lower axils, which do not expand, are fertilized in the bud, and are the chief flowers to produce seed. Conspicuous blue-purple

flowers from the upper axils bear seed occasionally, and are adapted to cross-fertilization. The keel and wings when depressed generally take their former positions again as in *Psoralea*, but often they do not, thus leaving the stamens and stigma exposed. The bearing of cleistogamous flowers has made accurate action of the keel less necessary.

Tecoma radicans does not occur wild except within the range of Trochilus colubris, our common humming-bird. The frequent visits of this bird to the flowers of the trumpet creeper are well known, and, indeed, it seems to be the only visitor welcomed. The corolla is 7 or 8 cm. long, 2 cm. across at the throat, narrowing to 3 mm. along the lower 2 cm. of its length. Bees crawling in find the tube too narrow below. None but the largest moths have probosces long enough, and for those that have the position of the flowers seems not to be favorable. The stamens are didynamous, both pairs lying near the roof of the corolla tube, stamens of the same pair uniting slightly at their tips, the anthers being directed downward, exposing the pollen. The style extends above and beyond them, the stigmas lying anterior to the longest stamens. The flower being synacmic, cross-fertilization is secured by the sensitiveness of the stigma lobes, these closing in 7 to 10 seconds in young flowers on being disturbed. Older flowers often require 30 or 40 seconds, even more, such slow action being manifestly insufficient. But rapidity is apt then to be no longer necessary, the pistil usually being already fertilized.

Mimulus alatus has a similar arrangement of stamens and style, but the flowers being synacmic, the stigma lobes often in contact with the style, insect visits infrequent, cross-fertilization is not insured. The length of the tube makes the honey inaccessible to smaller bees. The flowers are violet-purple in color, with two hairy ridges on the lower lip, separated by a groove leading to the proper entrance. In albino flowers the entrance is darker, tinged with purple.

Mimulus ringens is essentially the same.

Scrophularia nodosa is proterogynous, as is well known. In the bud both stamens and style lie along the lower side of the corolla, curving upward anteriorly. On development the style first moves forward in position, and after fertilization continues in the same direction until it laps over the lip below. The stamens then take up the same motion. This simplicity of motion is in marked contrast to the advancing and retreating motion of stamens and styles in most Labiatæ.

Ruellia strepens has blue-purple flowers 3 cm. long, contracted rapidly below, the lower half being so narrow as to shut out all insects having sucking organs less than 13 mm. in length. The honey is secreted from a gland at the base of the ovary. The didynamous stamens are scarcely exceeded in length by the style, whose stigma is unequally lobed, the lower lobe being down-curved and often coming in contact with the upper anthers. The corolla has stripes of darker purple leading into the tube, serving as guide marks. The corolla lasts for only one day, easily falling off if disturbed. There is no structure insuring cross-fertilization.

Pycnanthemum lanceolatum has dense clusters of small white flowers, spotted with purple. Although labiate, the effect is rather that of a four-lobed corolla; the moderately didynamous stamens seem placed at the four sinuses of the same, and the style has a nearly central position. The stamens mature first, and may still contain pollen when the stigmas become receptive, although as a rule they grow effete at an earlier date. While the proterandry is not well marked, and its honey but poorly defended from general depredations, the plant is remarkable among our common Labiatæ for the great variety of insect visitors, as indeed its open structure might suggest. The most frequent visitors among these are various bees, wasps, flies, and unknown dipterous insects. Although bees visit this plant and Scrophularia nodosa alike, I could rarely succeed during the same trip in winning them from one plant to the other by holding it in their path, although there was no trouble in winning them over to plants of the same species.

Monarda fistulosa in the bud has stamens and style erect, the latter seeming the longer, but being soon overtopped by the stamens, which mature first. As they grow effete, the style ascends, surpasses the stamens in length, spreads out the lobes, and is ready in its turn. Bees, in visiting the flowers, come in contact with the anthers and stigmas chiefly on leaving the plant, rarely touching the same while gathering the honey.

Brunella vulgaris has flowers whose upper lip is violet, and the remainder white. The anthers mature first; later the stigmas open so as to stand just above and a little behind the anthers. The sterile tooth seems intended to keep the anthers forward away from the stigma; in the lower pair, where this is not necessary, the size of the teeth is much diminished. A bee entering the corolla touches the anthers

first, pushing them back, and receiving fresh pollen. At the same time the stigma is being brought in contact with the old pollen as the bee presses it on its way in. So a somewhat similar result to that produced by different times of development is secured. The upper pair of anthers, at first close together, separate later, as if to avoid contact with the stigmas. Various gradations to flowers fertilizing themselves in the bud occur, in some of which the corolla never opens.

Stachys cordata in the bud has style and filaments curved forward beneath the lower lip. The stigmas are already separated, but not matured. When the flower opens the outer stamens stand before the inner ones, and the style lies behind them all. When the outer stamens have shed their pollen they move backward under the upper lip, and the inner stamens move forward to shed their pollen in turn. These also take their position under the upper lip, and the style takes their place. The stigma lobes have now separated more and are mature. The stamens, as seen, take up their position under the upper lip when effete, and do not move outward as recorded in S. palustris. The stamens have but one motion, *i. e.*, backward. When the outer stamens move backward, the upper lip does so likewise, and this makes it appear as though the inner stamens moved forward a little. Bees fertilize the flower.

EXPLANATION OF PLATE VIII.—1. *Psoralea Onobrychis;* *a*, *b*, anterior and lateral view; *c*, a lateral view, the petals of one side being removed; *d*, a petal of the keel and one of the wings attached.

2. *Lespedeza violacea;* *a*, *b*, anterior and lateral views; *c*, the androecium with the tip of the style projecting.

3. *Desmodium canescens;* *a*, *b*, anterior and lateral views; *c*, flower with the keel sprung; *d*, androecium with the style projecting.

4. *Scrophularia nodosa;* *a*, *b*, horizontal and vertical sections of a bud.

5. *Mimulus alatus;* *a*, the flower; *b*, a vertical section; *c*, an horizontal section seen from below.

6. *Silene regia;* *a*, *b*, *c*, successive stages in the coiling of the styles.

7. *Monarda fistulosa;* *a*, *b*, female and male states.

8. *Pycnanthemum lanceolatum;* *a*, *b*, male and female states; *c*, lateral view of male state; *d*, vertical section of the bud.

9. *Brunella vulgaris;* *a*, vertical section of bud; *b*, tip of style and stamens enlarged.

10. *Tecoma radicans;* *a*, horizontal section seen from below; *b*, vertical section of bud.

11. *Ruellia repens;* *a*, vertical section of flower; *b*, the stigma.

12. *Stachys cordata;* *a*, outer stamens mature; *b*, *c*, *d*, inner stamens mature; *e*, *f*, style in position, stigmas mature.

13. *Brunella vulgaris;* *a*, the flower; *b*, tips of the style and stamens enlarged.

All figures are one-third larger than nature.

Cambridge, Mass.

Description of a new fossil species of the genus Chara.

F. H. KNOWLTON.

Fossils that are now known to belong to the genus Chara were described by Dufourny de Villers, under the name of Vortex, as long ago as 1785.[1] They were regarded by him as small sea-urchins. Later, in 1807, Lamarck[2] described additional forms, under the name of Gyrogonites, which he regarded as minute univalve molluscs. This view obtained quite wide acceptance, and occurs in conchological works of the period,[3] and it was not until 1810 that Léman[4] first recognized and pointed out their true nature. Since that time upward of forty species have been recognized by paleobotanists, mostly from European localities. The only American species, so far as I can learn, is the doubtful *Chara* (?) *glomerata* described by Lesquereux[5] from the Green River group at Florissant, Colorado. As this species is founded upon leaf impressions, it lacks the precision which characterizes these species established upon the sporostegia or "fruits," as they are universally called by paleobotanists. These fruits are not absent from American deposits, as I am informed by Dr. C. A. White, of the United States Geological Survey, who has collected or observed them at various localities in the western territories; but they have generally been overlooked or neglected by collectors. I describe below a species which appears to be new.

Chara compressa n. sp. (figs. 1, 2).

Fruit (sporostegium) longitudinally much depressed, the height nearly one-fifth less than the width; apex obtuse or even slightly depressed; number of spirals, as observed in side view, ten.

Fig. 1. Fig. 2.

CHARA COMPRESSA, n. sp.

[1] Mem. l'Acad. Jun. 1785.
[2] Ann. d. Mus. d'hist. nat. vol. IX, 1807, p. 236, pl. xvii, fig. 7.
[3] Denys de Montfort. Conchylologie systematique.
[4] Ann. d. Mus. d'hist. nat. vol. xv, 1810, pl. 23. fig. 12.
[5] Cretaceous and Tertiary Floras, 1883, p. 135. pl. xxi. fig. 12.

Collected by Dr. C. A. White, two miles west of Wales, Utah, near old coal opening. The formation from which this species comes is the Wasatch group, the extreme lower member of the Tertiary, regarded by Dr. White as the equivalent of the Bitter Creek group of Powell, and the Vermillion Creek group of King. The matrix is a dark gray shale, weathering nearly white. The fruits are exceedingly numerous, and, in the weathered specimens, stand out in full relief, as they are much harder than the matrix.

This species bears considerable resemblance to some of the species described by Watelet[6] from the Paris basin, particularly *Chara depressa* and *C. onerata*. It differs from the former, which has only seven turns of the spiral visible in side view, and from the latter by its smaller size and also in the number of turns.

U. S. National Museum.

BRIEFER ARTICLES.

Veronica peregrina.—It may not be safe to lay it down as a rule, but there is no doubt in my mind that when we find almost every flower on a plant fertile, that plant may be classed as a self-fertilizer. It may be that cross-fertilization is a benefit to the race in the long run; the fact remains that where flowers are so arranged as to require external agency in poliination, the agents often fail to do the work, and numberless flowers are infertile. It is said by those who believe clover requires cross-fertilization that the flowers are barren in New Zealand and other places where the proper insect agents do not exist.

Almost all our common weeds, from this stand-point, would be self-fertilizers. Rarely, indeed, does a flower fail to produce seed. When we examine them closely we find that they are often so arranged that self-pollination alone is possible. Veronica peregrina is a good illustration. The two stamens are alternate with the upper lobe and bend over so that the anthers seem deposited on the apex of the stigma. The pollen-sacs burst almost simultaneously with the expansion of the corolla. The stigma is in receptive condition at the same time, and becomes covered with own-pollen. It would be difficult to conceive of any better arrangement for securing self-fertilization, aside from cleistogamy.—THOMAS MEEHAN.

[6] Descrip. d. pl. Foss. d. Bassin de Paris. Paris, 1866. pp. 50–56, pl. 15.

The paraffin-imbedding process in botany.—Within a few months there have appeared two articles[1] on this subject, and as the writer has been devoting some attention to it lately it may be of interest to some of the readers of the GAZETTE to state briefly the results obtained. It was found convenient to combine to some extent the methods given in the articles referred to, as neither was found in all respects satisfactory, and some simplifications of the processes were made which were found advantageous.

The experiments were made upon the germinating macrospores and the young embryos of Pilularia globulifera, and the results obtained warrant a very strong recommendation of the imbedding process where the sectioning of very delicate tissues is necessary; indeed, when the results thus obtained are compared with the imperfect and uncertain methods ordinarily used in such work, no one who has used both will, I think, hesitate as to their comparative merits. With the firmer plant tissues there is usually no necessity for any imbedding process, and owing to the time and care necessary to successfully apply this method it is not to be recommended in such cases.

In regard to the best hardening agents Schönland and Moll disagree, the former recommending alcohol, which Moll does not consider satisfactory, prefering chromic acid or the mixture of chromic, osmic and acetic acids used by Flemming. There is no question that for many purposes absolute alcohol is to be preferred, owing to its convenience and the perfection with which it ordinarily preserves all plant tissues. With mixtures of chromic, picric or osmic acid thorough washing is necessary after hardening; but, as Moll rightly remarks, where cuticularized cell-walls are present it is extremely difficult to get the paraffin to penetrate such membranes, whereas it is much easier where fixing solutions containing chromic acid are employed. A practical illustration of this was found in the very thick-walled macrospores of Pilularia.

After the material is thoroughly hardened, and in the case of alcoholic material allowed to remain for 24 hours in borax-carmine, it is treated as described by Schönland.[2] For the gradual transfer from 30 per cent. to absolute alcohol the Schultz apparatus[3] was found most serviceable.

The following method of imbedding was found practical and simple: A small paper box is made by taking a strip of pretty firm paper and winding it tightly about an ordinary cylindrical cork, fastening the paper with a little gum-arabic and holding it in place with a pin until dry. On taking out the pin the paper cylinder can, of course, be slipped off the cork. The box is completed by cutting out a round piece of paper of

[1] Schönland, Bot. Centralblatt, No. 22, 1887. Moll, BOT. GAZETTE, Jan. 1888.
[2] L. c., also BOT. GAZETTE, July 1887.
[3] Strasburger, Bot. Prak., II Edit.

exactly the size of the cylinder and putting this into the cylinder as the bottom of the box. The object to be imbedded is placed horizontally upon the bottom and the melted paraffin poured over it, after which the whole is placed in a shallow, flat-bottomed vessel filled with melted paraffin. Thus there is no possibility of the paraffin's escaping, which otherwise it is almost impossible to prevent, and there is also no necessity of handling the objects after they are once in the paraffin, which, in the case of small objects, is a great advantage. In case the objects are displaced in pouring the paraffin over them it is a simple matter to adjust them, using a heated needle for this purpose.

In order to insure thorough saturation the objects were usually left over night in the melted paraffin, and then, as in the articles mentioned, quickly cooled to avoid the formation of bubbles. The vessel containing the paper boxes may be exposed to the air for a few minutes until a thin film has formed over the surface of the paraffin in the latter, when these may be quickly lifted out and plunged into cold water. As soon as the paraffin is thoroughly hard, the pasted seam in the paper cylinder may be loosened with the blade of a knife or scalpel, when it will be found that the paper separates readily from the inclosed paraffin, and on removing the bottom of the box in the same way the result is a solid cylindrical block of paraffin with the object to be cut lying horizontally close to the smooth lower face, so that the sectioning is easily regulated.

Schönland[4] recommends paraffin with a melting point of about 45° C., but I found this much too soft to cut well, and prefer, as Moll recommends, a harder sort, melting at about 50° C. Schönland again says that a temperature above 50° C. is to be avoided, but in no case have I found that a temperature of 50°–55° C. was in the least degree hurtful.

For sectioning the rocking microtome used by Schönland was employed and found in every way satisfactory. With it it is possible to obtain series of sections, a very desirable thing in embryological investigations.

Moll[5] describes fully the fixing processes, but my experience has been that it is not desirable to hasten the staining process. Safranin was mainly used, and the best results were had by allowing the sections to remain for about twenty-four hours in a very dilute watery solution. At the end of this time they should be deeply stained. The slide is then plunged in absolute alcohol until the excess of the color is removed, and when this is accomplished and most of the alcohol has been removed from the slide with a cloth or blotting paper, taking care of course not to touch the sections, a few drops of xylol is applied and allowed to remain until the sections look perfectly transparent, when a drop of Canada balsam dissolved in xylol or chloroform may be applied and a cover-glass put over the preparation, which is now complete.

[4] L. c. [5] L. c.

The employment of soft paraffin in order to make the sections adhere, as described by Schönland, is quite unnecessary, as the sections adhere perfectly without this; indeed, it is much easier to get a good ribbon of sections without the soft paraffin than with it, owing to the difficulty of perfectly removing the surplus soft paraffin.—DOUGLAS H. CAMPBELL, *Berlin.*

Rules for the Botanical Exchange Club.—It having been decided to organize the American Botanical Exchange in connection with the national herbarium in the Department of Agriculture, the botanist of the department will act as director of the Exchange, and the following rules will be followed in its management until further notice:

1. Persons desiring specimens are required to contribute a number regarded as equivalent in value to those called for. The specimens wanted in return may be selected when the others are sent or at any time afterward.

2. The number of the specimens returned will be at the discretion of the director, and will depend on the rarity and condition of those furnished. In the case of well known plants they will probably nearly equal the number sent.

3. In the case of small plants, several specimens should be furnished under one number, as in such cases a single specimen is not a satisfactory representation of the species.

4. Specimens may be called for by species or genera, or by the locality from which they are wanted. To save time the species may be indicated by the numbers which they bear in any well known American catalogue, the name and the edition of the catalogue being given.

5. Specimens sent must be accurately named, and bear the date and locality of collecting, with the name of collector. Little value will be attached to specimens which are imperfect or poorly prepared.

6. The director of the Exchange will reserve the right to indicate his judgment in cases where specimens seem improperly named; but the responsibility of the names will in other cases rest with the original sender.

7. Well prepared specimens of all flowering plants and vascular cryptogams will be received, and also specimens of thallophytes, the last mentioned to be under the charge of the Chief of the section of Vegetable Pathology. Hereafter lists will be published of plants especially desired, or of which no more specimens are needed.

8. An account of the specimens received from each person will be kept, and of those sent in return, and, also, of any other specimens which he desires or can supply. The Exchange will thus serve as a bureau of information upon this subject.

9. Conditions of membership: Any botanist may become a member of the Exchange Club by paying annually to the director the sum of two

dollars; this money to be used in payment for postage, printing and incidental expenses.

10. Address specimens and communications to the director of the Exchange.

DR. GEO. VASEY,
Botanist, Department Agriculture.

Washington, D. C.

EDITORIAL.

THE NOMENCLATURE of vascular plants seems to be in somewhat of a ferment. The law of priority every one recognizes, and that mile-stone in our progress has been passed long since. The application of the law is the question just now, and one that must be settled. The way of settling it is of far less importance than to have it settled. Fixity is what we must have, and we must have it even at the expense of some of our most cherished prejudices. Shall the law of priority apply only to the combined generic and specific name, or to the specific appellation as well? All of us have prejudices, backed by very good reasons as well as sentiment, in favor of one or the other of these views. But it will never do for us to go ahead in sublime indifference of each other. To what a chaotic state would such a proceeding lead? It is hardly the thing for a monographer to carefully study some group and publish his results in a paper in which relationships are the chief thing, and names of very minor importance; and then for some catalogue-maker to hunt through the synonymy and give different names to many of the plants in a publication in which names are the chief things. We must work together, or justice will never be done to those to whom justice is due. It has occurred to us that we could reach some uniformity of action, if not of opinion, that would save American botany at least from the chaos toward which it seems drifting. Prejudice and sentiment, and the names of plants, are all of so much less importance than uniformity that they ought to be laid aside for the sake of any sort of an agreement. Would it not be a feasible thing to have this subject discussed by the Botanical Club next August at Cleveland? Some plan might be devised by which the opinions of all working botanists could be obtained, and upon this basis some mutual understanding might be reached. At any rate, a full discussion would do no harm.

OPEN LETTERS.

The Exchange Club.

My attention has been called to an article of Mr. A. A. Crozier's in the last number of the GAZETTE, concerning the proposed Botanical Exchange. This article did not emanate from the committee. The objectionable point in the article seems to be an obscure intimation that under

certain circumstances there might be no fees, and that the interchange of specimens might be made free of postage. This idea arose from the fact that this department often franks packages of plants which are sent as contributions to the herbarium, and we were discussing the question whether this could be made available for packages where only a certain percentage of the specimens were to be so applied. But such a plan would be open to objection, and will not be entertained. Small packages are very cheaply transmissible through the mails, and botanists will be glad to avail themselves of such advantages. A set of rules for the Exchange is published in this number of the GAZETTE. GEO. VASEY.

Department of Agriculture, Washington.

What shall be done with our Prosartes?

The books give eight species as belonging to the American genus *Prosartes*, which would rest there undisturbed did not Bentham, in the *Genera Plantarum*, refer them all to Salisbury's Asiatic *Disporum*. The two genera are certainly exactly alike to all appearance, but had been supposed to differ in the position of the ovules, the Asiatic species having them pendulous from near the top of the cells, and the American ascending from near the base. But Bentham states that in one Himalayan species and in our P. trachycarpa he had found the ovules attached laterally near the middle—which surely leaves very slight basis for two genera. This is a pity, as it is an advantage to keep the groups apart on account of their difference of habitat, the generic name at once revealing the home of any species. Whether Mr. Bentham was right I am not enough of a botanist to decide, even if I had the specimens for an independent comparison of the species. Botanists in a small way like myself must be content under such circumstances to adopt the master's decision without question.

Taking it for granted, therefore, that *Prosartes* can no longer stand, the question arises, what authority is to be cited for the species when transferred to *Disporum*? Inasmuch as Mr. Bentham is known with certainty and by his own statement to have worked up the *Liliaceæ* for the *Genera Plantarum*, and there transfers the genus *Prosartes* to *Disporum* bodily, without exception or question, it would naturally seem right to cite him as the authority for the several species. Our species, then, should be written as they are given below in column A. But the *Genera Plantarum* was a joint work, and though the orders were portioned out so that some were revised by Mr. Bentham alone, and others by Dr. Hooker, yet the whole was so explicitly indorsed by both, and was so published under the names of both, that no part can be attributed exclusively to either. Consequently, instead of crediting the species to Bentham alone, they must be given to Bentham and Hooker, as in column B.

But now it is affirmed that this will not do; that Bentham and Hooker can not be cited as authority for a name which they never wrote; that in all Bentham's or Hooker's, or Bentham and Hooker's, writings, no mention can be found of a species *Disporum Menziesii*, nor of any of the others excepting *D. trachycarpum*, which alone is expressly mentioned in the *Genera Plantarum*. As for the rest, it is asserted that we do not know, and have no right to infer and say, that if Bentham and Hooker had written out the list they would have done it as below, for they might have united or dropped some of the species, or found some reason to alter the specific names, so that we are "making them say what they do not say," and virtually falsifying the record in citing them as authority. It is asserted that

this so-called "authority" is simply an abbreviated citation of the place where the name itself is first to be found. Since, therefore, this is the first time, so far as I know, that these names have actually appeared in print, this article and its writer will for good truth's sake need to be cited, and the names must accordingly stand as in column C. This, certainly, is very gratifying to one's vanity, to know that through all time these names will go down with my name attached, and that by this unimportant article I have attained to a certain small degree of cheap immortality in the records of science. But, after all, this effort at truth appears to me to be rather like straining at a gnat and doing the other thing. For however much it may be insisted on that this "authority" is only an abbreviated citation, I am sure that those who make the assertion must be conscious at heart that the doctrine is essentially a fiction, got up in recent times for a purpose. The name of the person which is attached to the name of a plant is always spoken of as the "authority" for the plant-name. We have no other designation for it, and for the reason that the word expresses exactly the idea. The name is intended to indicate the person upon whose authority the plant-name rests, the one who first made a *Disporum* of *Prosartes Menziesii*, for example. That is the very point that we wish to know; no one cares to know who it may be that after the change is authorized chances to be the first to make use of the name. Now, in this case, I am no authority for the transfer, and am not the author of *Disporum Menziesii;* I am simply blindly following Bentham's lead, and expressing in words what he had previously said in fact. It appears to me a worse falsification of the fact to cite "N. or M." as authority in this case than it is of the record to cite "Benth. & Hook.," for it is denying that they made a *Disporum* of *Prosartes Menziesii*. As truly as the whole must include all its parts, and as the general also includes the particular, so truly did they make a *Disporum Menziesii* of *Prosartes Menziesii* when they said that *Prosartes* belonged in *Disporum*. It makes no difference that there might be already a D. Menziesii, and that there should not be two species of the same name in a genus, for there are actual cases of that very thing; nor does it make any difference what other questions there may be as to validity of species, correctness of nomenclature, or whatever else. All these questions can remain in abeyance as well under *Disporum* as under *Prosartes*, the one statement holding good that all the known and reputed species of *Prosartes*, such as they are, are now, in the judgment of Benth. & Hook., species of *Disporum*, subject to the same criticism in that genus as in the other.

Suppose, now, that, instead of adopting their conclusion, I were here combating it and refusing to accept it, but had occasion in the course of my article to name the species as if under *Disporum*. According to this rule I must still be cited as authority for the species just the same. Absurdity in this matter could not easily go much further, yet this does not seem to me very much more absurd than the other.

To take another example, Benth. & Hook. transferred Engelman's cruciferous genus *Dithyræa* to *Biscutella*, stating, simply, that there were two species, but not giving their names. Dr. Watson, in his "Index," accepting their identification, entered the two species B. Californica and B. Wislizeni, and cited honestly, as he doubtless thought, "Benth. & Hook., *Gen. P.*," as his authority. It has been said that this is wrong, as it makes Benth. & Hook. say what they do not say, and that the only absolutely correct thing now to do is to cite Watson as authority for the species (supposing that these names first appeared in the "Index," which happens not to be the case). But this, again, is just as much a falsification

of the record as the other, making now Watson say what he does not say, and representing him as claiming authorship of the species—the very thing he is careful not to do. A correct citation of the "Index" would be "*Biscutella Californica* Benth. & Hook, ex Watson, etc.," which shows exactly what Watson says. This, in the ordinary course of abbreviation, becomes "*B. Californica* Benth. & Hook.," just as we cite Nuttall as authority for numerous species which he never published, "Nutt." being a convenient abbreviation of "Nutt., ex Torr. & Gray," or "Nutt., ex DC. Prodr.," etc.

This instance illustrates, also, another point, viz.: the difficulty of determining with certainty in any case who was really the first to use the new name. It may have first appeared in an overlooked catalogue or journal, or other out of the way publication, and any authority supposed to-day to be correctly given is liable to be ousted to-morrow. Not a few cases have occurred where a writer in the supposed application of the rule has innocently written his own name as authority for a species, to find a little later that some happier mortal was in advance of him.

But to return to our new species of *Disporum*. They are now, according to rule, under the assumed authorship of "N. or M.," and the absurdity of perpetuating an anonymous authority of this or any sort is evident. What shall be done? If we can not go back to "Benth. & Hook." we must go forward, and the only alternative that occurs to me is to cite the "GAZETTE." Under the usual formula "Coult. Bot. Gazette," therefore, the names will now appear as in column D. That looks well. But why single out one from among the worthy editors of the GAZETTE to father these poor foundlings? It can not be denied that they have an equal claim upon all three, and that "Arthur, Barnes & Coulter" is the only legitimate resource. In the necessary process of condensation this becomes inevitably A. B. C., and thus the column E is filled, and, having reached this conlusion, we have found at last an answer to the question with which we started.

A.	B.	C.	D.	E.
Disporum Menziesii, Benth.	Benth. & Hook.	N. or M.	Coult.	A. B. C.
Disporum lanuginosum, Benth.	Behth. & Hook.	N. or M.	Coult.	A. B. C.
Disporum maculatum, Benth.	Benth. & Hook.	N. or M.	Coult.	A. B. C.
Disporum trachycarpum, Benth.	Benth. & Hook.	Benth. & H.	Benth. & H.	Benth. & H.
Disporum Hookeri, Benth.	Benth. & Hook.	N. or M.	Coult.	A. B. C.
Disporum trachyandrum, Benth.	Benth. & Hook.	N. or M.	Coult.	A. B. C.
Disporum Oreganum, Benth.	Benth. & Hook.	N. or M.	Coult.	A. B. C.
Disporum parvifolium, Benth.	Benth. & Hook.	N. or M.	Coult.	A. B. C.

N. OR M.

From Northern Idaho.[1]

From Camp Lakeside, at the south end of Lake Pend d' Oreille, Mr. Leiberg writes:

"I send by this mail a package of seventy species of mosses. They have been nearly all collected during the past three weeks, within a radius of two miles of this place, which is our winter camp. I have not yet col-

[1]We "open" some private letters from Mr. John B. Leiberg, who is prospecting in Northern Idaho, to give our readers some glimpses of his botanical observations. Although almost constantly in the saddle, Mr. Leiberg finds time to collect the plants of the region, and has sent in a number of new species.—EDS.

lected at any great heights, as the snow lies several feet deep on the high peaks and ridges that surround us here. In about a month we will be able to cross over into the great North Fork of the Cœur d' Alene River basin, which lies immediately to the east of us. This basin abounds in high peaks, deep, dark cañons and chasms, waterfalls and cascades—just the conditions best suited to produce a flourishing growth of mosses, and I expect a rich harvest in these places. While this is a difficult country to collect in, one has at least the satisfaction of knowing that he is on ground on which *no one* has ever before collected. . . . .

"The moss flora seems to be wonderfully well developed here. To date I have observed over 110 species within a radius of four miles. I do not think it would be an overestimate to count upon at least 500 species of mosses for Kootenai county. But it must be remembered that this county covers a large area—nearly 7,000 square miles—and that nearly all conditions of climate and soil in the temperate regions of North America are found here. Lichens and fungi also abound in these excessively damp woods. . . . .

"At the northeast angle of the lake, about fifty miles from here, where Clark's Fork of the Columbia enters the lake, there exists a great subaqueous bank composed of the silt carried down by the river. Usually, during the months of August, September and October, the water is only two to three feet deep over some six square miles of this bank, and here grow and flourish Charas as possibly in no other place in the United States. The greater portion of the lake is without vegetation (except diatoms and desmids, which are found nearly everywhere), as the water averages 1,000 feet in depth; but wherever a shallow spot exists Charas grow the year around, for the waters of the lake freeze only in a few circumscribed localities. . . . .

"For many months whenever collecting I have searched for fertile specimens of Neckera Menziesii, but always in vain, until I had begun to think that it never fruited in this latitude. Judge of my surprise and delight when, a few days ago, I discovered on the bare face of a huge granite ledge a large tuft of N. Menziesii fruiting abundantly! This find has stimulated my endeavors to find fruiting specimens of the other sterile mosses I have collected here. . . . .

"As the season advances the species of Hypnum are coming to the front fast. There is an immense variety of this genus around here, and I add some every day to my collections. . . . .

"I am glad to hear that the water-lily was a new one [Castalia Leibergi, described in the May number of the GAZETTE], but the most remarkable circumstance is that so conspicuous a plant should have remained undiscovered by western botanists. It is hardly to be supposed that the insignificant little pond in which I found it growing is its only habitat. In this particular pond it is very abundant, growing with Nuphar polysepalum and Brasenia peltata among others. . . . ."

CURRENT LITERATURE.

Flora of the Hawaiian Islands.[1]

Insular floras are always peculiarly interesting, and few are more so than that of the Hawaiian Islands. Lying so far removed from all continents, these islands present important problems to the geographical botanist. During a residence of twenty years Dr. Hillebrand unremittingly studied the Hawaiian flora, thoroughly exploring the whole region and cultivating very many of its native plants. This book, embodying as it does the results of such protracted study, is more than a mere manual, for it contains most valuable notes upon the peculiarities of the flora and offers many suggestions as to its origin. It is a pity that the author was not spared to correct the proof-sheets and to develop his notes, which are given as mere memoranda, but the editing has evidently been very conscientiously done by his son, assisted by Professor Askenasy, of Heidelberg. An introduction of twenty pages gives a general account of the position and nature of the Hawaiian Islands, as well as the striking features of its flora. Then follows Mr. Bentham's "Outlines of Botany," from his British and Colonial Floras, with a good glossary. The diversity of conditions, and hence of the flora, of the different islands is so great that in our limited space we can give no account of it, although it is presented in a very clear and interesting way. Five different zones of elevation are described, called the "lowland zone," mostly grass-covered after rains, with isolated clumps of trees; the "lower forest zone," with rather open woods, characterized by the pale green foliage of Aleurites Moluccana; the "middle forest zone," within the region of the clouds, and luxuriant in trees and jungle, and with a great exhibition of Lobeliaceæ, "the peculiar pride of the flora;" the "upper forest zone," characterized by stunted trees; the "bog-flora" of the high table-land of certain islands. A comparison with other floras brings out the striking difference in the great number of varieties in all the species of the principal genera, as though nature had run wild in the production of diverse forms. These islands seem to be the only ones of the Polynesian group which contain a large proportion of indigenous plants with American affinities, while Australian types are wanting or very scantily represented. Southern Asiatic types are few, and many of them have probably been carried over by the aborigines. The entire absence of gymnosperms is one of the notable features of the flora, as well as the low size of all the trees, none but the cocoa-nut palm exceeding 100 feet, the usual height of the largest trees being 50 or 60 feet. Nearly all the native plants are perennial and

[1] HILLEBRAND, DR. WILLIAM.—Flora of the Hawaiian Islands: a description of their phanerogams and vascular cryptogams. Annotated and published after the author's death by W. F. Hillebrand. xcvi and 673 pp., with 8 maps, 8vo. Heidelberg: Carl Winter, University Bookseller, 1888. [Williams & Norgate, London. B. Westermann & Co., New York.]

woody. This volume describes 844 species of phanerogams, representing 335 genera, and 155 pteridophytes with 30 genera, making a total of 999 species. It is believed that 115 of these species have been introduced since the discovery by Captain Cook in 1779, and 24 species by the natives in prehistoric times. This leaves 860 species as original inhabitants, of which no less than 653 are endemic, or over 75 per cent. Of this 653 endemic species 250 belong to endemic genera. Considering dicotyledons alone, over 85 per cent. of their species are endemic. This character is strikingly shown in Lobeliaceæ, of which 58 species are known, all endemic, belonging to 6 genera, 5 of which are endemic. It is needless to say that the volume abounds in new species, and illustrates in every page the fact that it deals with a long isolated flora.

The geological history of plants.[2]

It had been known for some time that a work was being prepared by Sir William Dawson on the geological history and development of vegetation, and its appearance was anxiously looked forward to, in hope that we should at last have an American work, illustrated by American material, and clearly abreast of the times. The work is before us, and, after a thorough examination, we can not repress a general feeling of disappointment that it is not what was expected from one seemingly so well qualified, although in some particulars it is very satisfactory, and must be of permanent value. The opening chapter deals with the evidences of the existence of plant life in the so-called azoic formation, and the facts adduced are of the most convincing nature. The presence of the immense beds of iron ore, which, so far as now known, can only be deposited in the presence of decaying organic matter, is a strong presumptive argument, as is also the presence of beds of graphite, which, according to Sir W. E. Logan, aggregate in the Laurentian a thickness of more than thirty-five hundred feet. The oldest unquestionable plant remains admitted by Dawson, from the Skiddaw rocks of Cumberland, are called by him Protannularia, since he regards it as being allied to the carboniferous genus Annularia. These are regarded not as algæ, but as Rhizocarps, and with the Protostigma of Lesquereux indicate the presence of the Rhizocarpeæ and Lycopodiaceæ in the Silurio-Cambrian. The supposed taxine wood first called Prototaxites by Sir William he now regards as probably the stem of a gigantic sea-weed, as was long ago pointed out by Carruthers. The problematical organisms, which have until lately been regarded as plants, Dawson concludes, with some of the European scientists, must probably represent the tracks or burrows of worms. Under this head he places the so-called genera Bilobites, Rusichnites, Paleophycus, Buthrotrephis, etc. In the Devonian, and particularly in the upper portion to which the name Erian has been given,

[2] DAWSON, SIR J. WILLIAM.—The Geological History of Plants. Vol. LXI, Internat. Sci. Series. 12°. New York: D. Appleton & Co. 1888.

the vegetation became more pronounced, and we find ferns, Equisetaceæ, Sigillarieæ, Lepidodendreæ, etc., in comparative abundance. We can not, however, agree with the author that the Taxineæ or yews extend into the Devonian, or, indeed, into the Carboniferous. The species described as Dadoxylon undoubtedly represents the wood of Cordaites, as is shown by the fact that they all possess an Artisia pith, slit-form bordered pores covering the entire radial walls of the tracheïds. Cordaites is a typical paleozoic genus which is allied to the cycads on one hand and the conifers on the other, and the characters as established by Grand 'Eury and Renault, who have so successfully worked up the European material, agree with all of Dawson's species Dadoxylon. The *Araucarites gracilis*, thought to represent the leaves of a species of Dadoxylon, is probably a species of Walchia, a Permian genus.

Another debatable point is the relationship of the Sigillarieæ. Since the admirable researches of Williamson on the internal structure, and the discovery by Zeiller of cones containing both microspores and macrospores, their position among the cryptogams, although possessing an exogenous mode of growth, seems to be clearly defined, and the prediction that it will ultimately be proved that there are two branches of the family, one coniferous and the other cryptogamous, is not likely to be fulfilled.

In speaking of the transition from cryptogams to phænogams Sir William thinks it probable that these have been their lines of connection, "one leading from the Lycopods by the Sigillarieæ, another leading by the Cordaites, and the third leading from the Equisetums by the Calamites." After making this unequivocal admission he makes haste to say: "I do not make these remarks in a Darwinian sense, but merely to state what appear to be the lines of natural affinity, and the links wanting to give unity to the system of nature." It seems almost incredible in this state of scientific thought that a denial of the doctrine of evolution, especially in a work on the development of vegetation, should be deemed expedient.

The remaining chapters of the work are devoted to Mesozoic and Tertiary vegetation, and as the deposits containing these happen not to be very well developed within the British provinces, the account becomes in consequence meager and incomplete; in fact, the omissions of the whole work "correspond," as has been said by another reviewer, "with the imperfections of the geologic record in the locality studied by the author."

The illustrations, about eighty in number, are, almost without exception, from earlier published works on Canadian plants by the author.

The Flora of Miquelon.

The double island off the south shore of Newfoundland known as Miquelon has been pretty thoroughly explored by Dr. Delamare, and the

results of his collecting and notes appear in collected form in this admirable "Flora Miquelonensis."[3] Dr. Delamare has been assisted in the preparation of this little work by a number of specialists, some of whose names appear as joint authors. The flora contains a description of the topography, climate and superficial geology of the isle, extended remarks on the relative distribution of the phanerogams, with interesting notes on various matters. The introduced and cultivated species are indicated, and also species found by de la Pylaie. Of the cryptogams, the ninety-four species of mosses are treated at greatest length, and the list contains descriptions of several new varieties and one new species, *Dicranum Miquelonense* Ren. et Card., and a new sub-species of Rhacomitrium canescens, viz.: *R. Delamarei* R. & C. Only four species are extra-European. Five species new to North America are included in the list. Among Sphagnaceæ, out of the twenty species and sub-species common to Europe and North America, only four have not been found in Miquelon, which shows how unusually rich the island is in the peat mosses. Thirty-seven species of Hepaticæ, 126 of Lichens and forty-three of marine Algæ are also listed. In general, the character of the phanerogamic flora is strongly American (46 per cent.) and boreal, whereas the cryptogamic flora greatly resembles that of the mountains and northern parts of Europe. The island of Saint Pierre, a league away, which was long ago explored by de la Pylaie, receives but scant notice in this paper, which is an admirable contribution to geographical botany.

Our Native Ferns.[4]

It is quite fortunate that so soon after the destruction of the remainder of the second edition of this handy manual we are able to notice the third edition. The fact that the first edition was published no longer ago than 1881 is evidence enough of the value of this little book and that it has a place to fill. In the first edition 140 species of true ferns were described. This number is now augmented by nineteen, and three of the former species reduced to varieties. The fern allies receive the accession of one genus, Salvinia, and eight species, while three former species have been reduced in rank. The first ten chapters, that is about half of the book, deal with the life-history, structure and relationships of the pteridophytes. The latter half is occupied with condensed and accurate descriptions of the species, accompanied by well-made analytic keys which lead the user to within one or two species of the determina-

[3] DELAMARE, E., RENAULD, F., CARDOT, J.—Flora Miquelonensis: Florule de l'île Miquelon (Amerique du Nord), énumération systématique avec notes descriptives des Phanérogames, Cryptogames vasculaires, Mousses, Sphaignes, Hépatiques et Lichen. pp. 79, 8vo. Lyon: Association Typographique, 1888.

[4] UNDERWOOD, LUCIEN M.—Our native ferns and their allies, with synoptical descriptions of the American Pteridophyta north of Mexico. Third edition, revised. pp. xii, 156, figs. 35. 12mo. New York: Henry Holt & Co., 1888.

tion. This feature, for the purposes of such a book, is especially to be commended. Of much value also are the abundant references to the American sources of information about our native pteridophytes. The whole text is exceedingly satisfactory, and will do very much to stimulate the user to a closer acquaintance with our ferns and to make of him an acute observer, or even an original investigator. The typography is worthy of the text. It would have been a happy thing, however, for the new publisher to have improved the quality of a few of the illustrations.

Minor Notices.

MR. WOODWORTH, working in Dr. Farlow's laboratory, has investigated the growing point of Fucus,[5] using F. furcatus first, and confirming his results upon F. vesiculosus and F. filiformis. While Reinke and Rostafinski found what they considered a group of cells, Woodworth sees a single initial cell, four-sided, wedge-shaped, with convex sides, the smaller upper end being rounded and the base truncated, with its greater diameter at right angles to the broad surface of the frond. Woodworth was able to observe the relations of the cells accurately by imbedding the tips of the fronds in paraffin and cutting ribbon serial sections, and his results are confirmed by their agreement with what is known of related species and cryptogams in general.

WE HAVE HAD many guesses, and some shrewd ones, as to whether our Sarracenias profit by their insect-catching arrangements. Dr. W. P. Wilson has undertaken to investigate these plants thoroughly. A preliminary report[6] of some work deals with the morphology of the leaves of our common northern and southern species. Both species form small early leaves unlike the mature ones. Those of S. purpurea are miniatures of the mature leaves of S. variolaris, and *vice versa*. This fact and the rudimentary character of its honey glands lead to the conclusion that S. purpurea is a retrograde development from S. variolaris. This conclusion is confirmed by the fact that S. variolaris secretes a considerable amount of a digestive ferment which dissolves the soft parts of insects, while S. purpurea produces but a trace of it.

OF LOCAL FLORAS, Milwaukee county, Wisconsin, has had more than a fair share. Mr. Lapham's assiduous collecting was supplemented by his permanent record in various lists of the flora of Milwaukee and vicinity. The last list by Mr. Wheeler,[7] curator of the Milwaukee public museum, includes 691 Phanerogams and vascular Cryptogams, of which 567

[5] WOODWORTH, W. MCMICHAEL.—The apical cell of Fucus. (Contrib. from Crypt. Lab. Harvard Univ. ix). pp. 9, pl. 1. 8vo. Reprinted from *Annals of Botany*, Feb., 1888.

[6] WILSON. W. P.—On the relation of Sarracenia purpurea to variolaris. p. 1. 8°. Proc. Acad. Nat. Sci. Phila., Feb. 20, 1888.

[7] WHEELER, W. M.—Flora of Milwaukee County. pp. 154-190. 8vo.—Extract from Proc. Nat. Hist Soc. of Wisconsin, April, 1888.

are indigenous to the state. 124 species are, therefore, introduced, of which 113 come from Europe, and probably many of them directly from Germany. The list is prefaced by some remarks on the topography and climate of the county. It does not seem to be founded upon preserved specimens, which is unfortunate.

A PRELIMINARY catalogue[8] of the vascular plants growing within a hundred miles of New York City has been issued by the Torrey Botanical Club. The boundary line is quite an arbitrary one, but probably limits the work as well as if it was more natural. A list of ballast plants is also included, and presents a formidable array of foreigners who have landed upon our shores, the great majority of whom, it is to be hoped, will find no welcome. The noticeable thing about the catalogue is its innovations in respect to specific names, for which, we are told, the subcommittee on nomenclature, consisting of Messrs. Britton, Sterns and Poggenburg, "alone are responsible."

NOTES AND NEWS.

DR. CHARLES E. BESSEY, of the University of Nebraska, sails for Europe June 16 to spend the summer.

THE FIRST PART of the seventh volume of Saccardo's Sylloge Fungorum is issued, and will hereafter receive suitable notice.

MR. M. S. BEBB describes (with plate) Salix balsamifera in *Bull. Torr. Bot. Club* (May), and gives an account of its discovery in the White Mountains.

ARCHÆOPHYTON NEWBERRYANUM is the name of a supposed Archæan plant described (with plate) by Dr. N. L. Britton in *Annals N. Y. Acad.* iv., 123.

RECENTLY FIGURED North American plants in *Garden and Forest* are *Rosa minutifolia* Eng. (April 25), *Hymenocallis humilis* Watson (May 2), *H. Pulmeri* Watson (May 16).

DR. H. H. RUSBY, of Columbia College, has distributed a reprint of his interesting paper, "Coca at home and abroad," published in the *Therapeutic Gazette* for March and May.

MR. GEORGE MASSEE has published a revision of the genus Bovista in *Journal of Botany* (May). The genus is credited with thirty-nine species, four of which are described as new.

THE REVISION of Scotch Sphæropsideæ and Melanconieæ by Prof. J. W. H. Trail is brought to a close with 223 species in the *Scottish Naturalist* for April. It is a list of species and habitats with a key to the genera, but without descriptions of the species.

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[8] Preliminary Catalogue of Anthophyta and Pteridophyta reported as growing spontaneously within a hundred miles of New York City. Compiled by a committee of the Torrey Botanical Club. xviii and 90 pp., with map. New York, 1888. Price, $1.

AN INDEX of the habitats of the fungi in Ellis' *North American Fungi*, cent. XI to XX., has been compiled and published by W. C. Stevenson, Jr. It will prove a great service to users of the work.

THE KEW BULLETIN for May contains information concerning ipecacuanha, Brazilian gum-arabic, Trinidad coffee, patchouli, Cochin China vine, Madagascar ebony and Shantung cabbage.

DR. CHAS. E. BESSEY has published a pamphlet entitled "Grasses and Forage Plants of Nebraska." It is of great interest to the farmers of that country, and contains twenty plates of the common grasses.

DR. HUBERT LEITGEB, well known for his classical researches on the Hepaticæ, professor of botany and director of the Botanical Institute at Graz, died on the 5th of April, in the fifty-third year of his age.

IN THE *Italian Journal of Botany* (April 7) there are described numerous cases of teratology, illustrated with four plates, thus bringing together a large amount of information for those interested in this subject.

A SUPPLEMENTAL list of works on North American fungi, by Dr. Farlow, has been issued as No. 31 of the bibliographical contributions of the library of Harvard University, being a continuation of No. 25.

THE PARTS comprising the Gamopetalæ of Gray's Synoptical Flora have been collected and issued in one volume, as No. xxxi of the Smithsonian Miscellaneous Collections. Corrections have been made, as far as could be done upon the electrotype plates.

DIRECTIONS for preparing twenty-three fungicide solutions or powders are given in a special bulletin of the section of vegetable pathology of the Department of Agriculture. The value of most and the best time and methods for applying them remain to be tested.

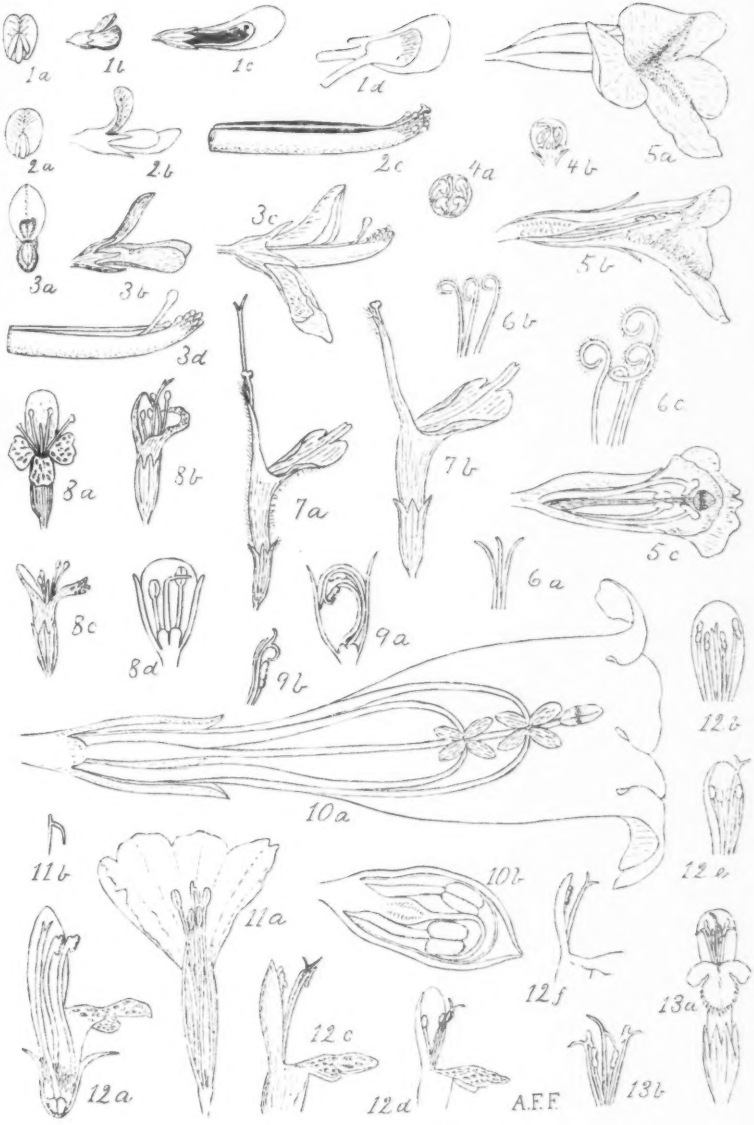
THE BULLETIN of the Botanical Department of the State Agricultural College of Iowa for 1888 has been issued. It contains the account of a large amount of work done by Dr. B. D. Halsted and his pupils. Almost every region of botany is touched upon, from bacteria to Iowa weeds.

A NEW Peronospora, P. Lapponica, from Lapland, on Euphrasia officinalis, is described in the last *Botaniska Notiser* (p. 49). It differs from P. densa on the same pest by its larger and colored conidia, and more closely resembles P. sordida. It should be looked for by collectors in America.

THE "Gray Memorial Botanical Chapter" of the Agassiz Association has a good constitution and ought to be a very successful organization. Its members are scattered through several states, the president being G. H. Hicks, of Grayling, Mich., the secretary E. L. Byington, of Colorado Springs, Colorado.

DR. C. WARNSTORF, of Neuruppin, Germany, has begun the issue of a collection of European Sphagnaceæ. The first century contains numerous new forms. The labels bear not only the usual data, but descriptions of the new forms, with critical remarks and drawings of the branch and stem-leaves, sections of the branch-leaves, etc.

DR. JULIUS RÖLL, of Darmstadt, accompanied by Mr. Albert Purpus, has undertaken a collecting tour along the line of the Northern Pacific Railroad. Dr. Röll will give special attention to collecting mosses, and hopes to bring back a valuable collection. Vancouver Island is their first objective point, whence they will gradually work back to St. Paul.



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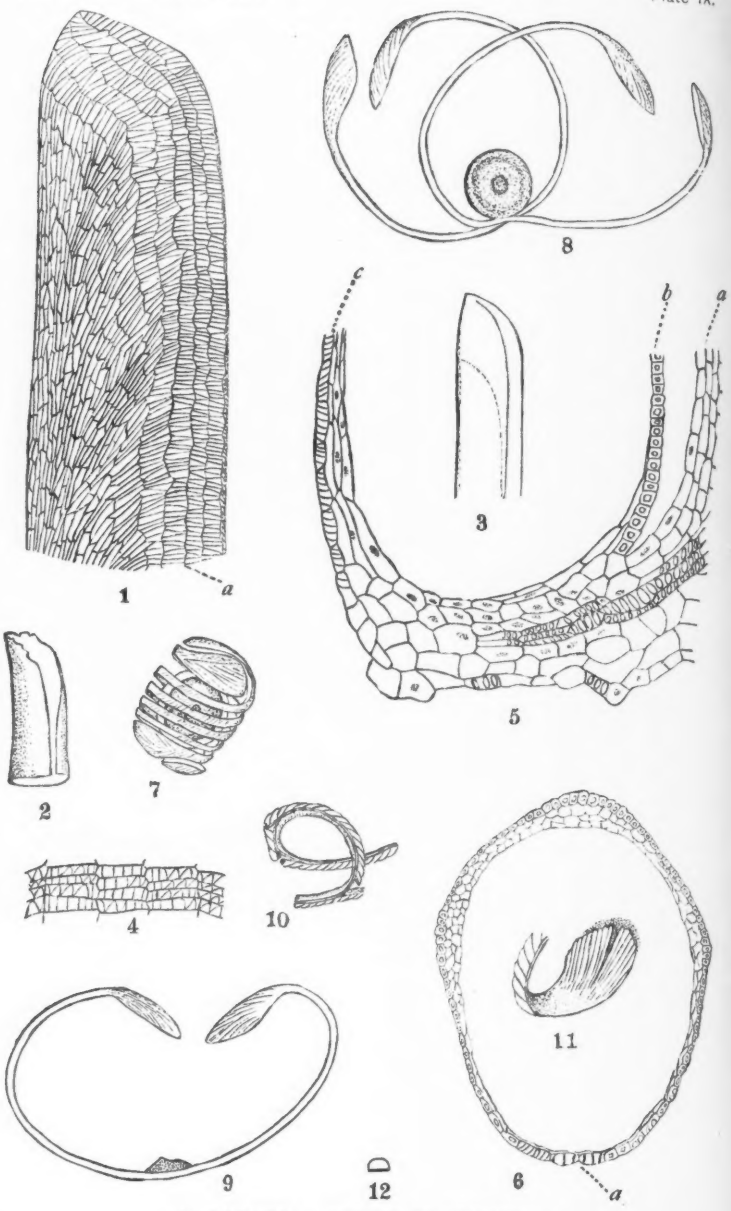

NEWCOMBE on SPORES OF EQUISETUM.